Material Safety Data Sheet

Lewisite

Date: 16 April 1988
Revised: 4 October 1999

In the event of an emergency
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:
U.S. Army Soldier and Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Registry Number: 541-25-3

Chemical Name: Dichloro- (2-chlorovinyl) arsine

Trade name and synonyms:
Arsine, (2-chlorovinyl) dichloro-
Arsonous dichloride, (2-chloroethenyl)
Chlorovinylarsine dichloride
2-Chlorovinyldichloroarsine
Beta-Chlorovinyldichloroarsine
Lewisite
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EA 1034

Material Safety Data Sheet

Lethal Nerve Agent (VX)

Date: 14 September 1988
Revised: 13 August 2001

In the event of an emergency:
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:
U.S. Army Soldier and Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Registry Numbers:
50782-69-9, 51848-47-6, 53800-40-1, 70938-84-0

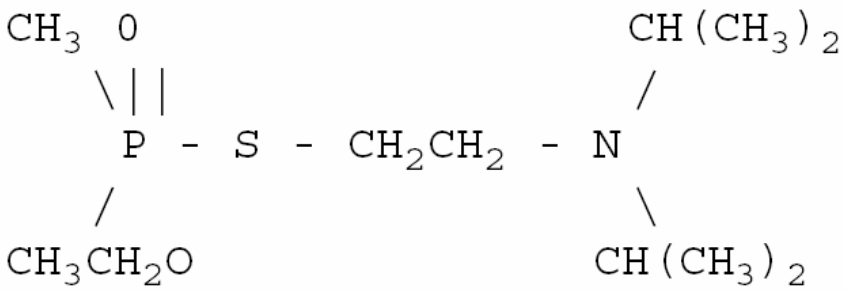
Chemical Name:
O-ethyl S-[2-(diisopropylamino)ethyl] methylphosphonothiolate

Trade Name And Synonyms:
Phosphonothioic acid, methyl-, S-(2-bis(1-methylethylamino)ethyl) 0-ethyl ester O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothiolate
S-2-Diisopropylaminoethyl O-ethyl methylphosphonothioate
S-2((2-Diisopropylamino)ethyl) O-ethyl methylphosphonothiolate
O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothioate
O-ethyl S-(2-diisopropylaminoethyl) methylthiolphosphonoate
S-(2-diisopropylaminoethyl) o-ethyl methyl phosphonothiolate
Ethyl-S-dimethylaminoethyl methylphosphonothiolate VX
EA 1701
TX60

Chemical Family: Sulfonated organophosphorous compound

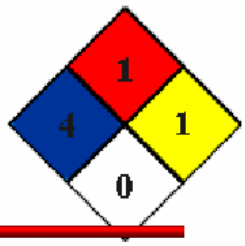
Formula/Chemical Structure:

$C_{11}\ H_{26}\ N\ O_2\ P\ S$



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0



Section II - Ingredients

Ingredients/Name: VX

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.00001mg/m^3

Section III - Physical Data

Boiling Point @ 760 mm Hg: 568 °F (298 °C)

Vapor Pressure: 0.00063 mm Hg @ 25 °C

Vapor Density (Air = 1 STP): 9.2 @ 25 °C

Solubility (g/100g solvent): 5.0 @ 21.5 °C and 3.0 @ 25 °C in water. Soluble in organic solvents.

Specific Gravity (H_20=1g/mL@25 °C): 1.0113

Freezing/Melting Point (°C): -50 °C

Liquid Density: 1.0083 g/mL@25 °C

Volatility: 8.9 mg/m^3 @ 25 °C

Viscosity (CENTISTOKES): 9.958 @ 25 °C

Appearance and Odor: Colorless to straw colored liquid and oderless, similar in appearance to motor oil.

Section IV - Fire and Explosion Data

Flashpoint: 159 °C (McCutchan - Young)

Flammability Limits (% By Volume): Not Available

Lower Explosive Limit: Not Applicable.

Upper Explosive Limit: Not Applicable

Extinguishing Media: Water mist, fog, foam, CO_2. Avoid using extinguishing methods that will cause splashing or spreading of the VX.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving VX should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing VX, fire fighting personnel should wear full firefighter protective clothing during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII). Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid VX or vapors can be fatal.

Unusual Fire And Explosion Hazards: None known.

Section V - Health Hazard Data

Airborne Exposure Limits (AEL): The permissible airborne exposure concentration for VX for an 8-hour workday of a 40-hour work week is an 8-hour time weighted average (TWA) of 0.00001 mg/m^3. This value can be found in "DA Pam 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for VX.

VX is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

Effects of Overexposure: VX is a lethal cholinesterase inhibitor. Doses which are potentially life-threatening may be only slightly larger than those producing least effects. Death usually occurs within 15 minutes after absorption of a fatal dosage.

Route	*Form*	*Effect*	*Type*	*Dosage*

ocular	vapor	miosis	ECt50	<0.09 mg-min/m^3
Inhalation	vapor	runny nose	ECt50	<0.09 mg-min/m^3
Inhalation (15 l/min)	vapor	severe incapacitation	ICt50	<25 mg-min/m^3
Inhalation (15 l/min)	vapor	death	LCt50	<30 mg-min/m^3
Percutaneous	liquid	death	LD50	<10 mg/70 kg man minutes

Effective dosages for vapor are estimated for exposure durations of 2-10 minutes.

Symptoms of overexposure may occur within minutes or hours, depending upon the dose. They include: miosis (constriction of pupils) and visual effects, headaches and pressure sensation, runny nose and nasal congestion, salivation, tightness in the chest, nausea, vomiting, giddiness, anxiety, difficulty in thinking, difficulty sleeping, nightmares, muscle twitches, tremors, weakness, abdominal cramps, diarrhea, involuntary urination and defecation. With severe exposure symptoms progress to convulsions and respiratory failure.

Emergency and First Aid Procedures:

Inhalation: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, incoordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by a physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when mask-bag or oxygen delivery'systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention **Immediately**.

Eye Contact: Immediately flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken **Immediately** to a medical treatment facility for observation.

Skin Contact: Don respiratory protective mask and remove contaminated clothing. Immediately wash contaminated skin with copious amounts of soap and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove excess decontaminant. Administer nerve agent antidote kit, Mark I, only if local sweating and muscular twitching symptoms are observed. Seek medical attention **Immediately**.

Ingestion: Do not induce vomiting. First symptoms are likely to be gastrointestinal. **Immediately** administer Nerve Agent Antidote Kit, Mark I.

Seek medical attention **Immediately**.

Section VI - Reactivity Data

Stability: Relatively stable at room temperature. Unstabilized VX of 95% purity decomposes at a rate of 5% a month at 71 °C.

Incompatibility: Negligible on brass, steel, and aluminum.

Hazardous Decomposition Products: During a basic hydrolysis of VX up to 10% of the agent is converted to diisopropylaminoethyl methylphosphonothioic acid (EA2192). Based on the concentration of EA2192 expected to be formed during hydrolysis and its toxicity (1.4 mg/kg dermal in rabbit at 24 hours in a 10/90 wt.% ethanol/water solution), a Class B poison would result. The large scale decon procedure, which uses both HTH and NaOH, destroys VX by oxidation and hydrolysis. Typically the large scale product contains 0.2 - 0.4 wt.% EA2192 at 24 hours. At pH 12, the EA2192 in the large scale product has a half-life of about 14 days. Thus, the 90-day holding period at pH 12 results in about a 64-fold reduction of EA2192 (six half-lives). This holding period is sufficient to reduce the toxicity of the product below that of a Class B poison. Other less toxic products are ethyl methylphosphonic acid, methylphosphinic acid, diisopropyaminoethyl mercaptan, diethyl methylphosphonate, and ethanol. The small scale decontamination procedure uses sufficient HTH to oxidize all VX thus no EA2192 is formed.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, And Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled:

If leaks or spills of VX occur, only personnel in full protective clothing (See Section VIII) will remain in the area. In case of personnel contamination see Section V for emergency and first aid instructions.

Recommended Field Procedures (For Quantities Greater Than 50 Grams):

Note: These procedures can only be used with the approval of the Risk Manager or qualified safety professionals). Spills must be contained by covering with vermiculite, diatomaceous earth, clay or fine sand. An alcoholic HTH mixture is prepared by adding 100 milliliters of denatured ethanol to a 900-milliliter slurry of 10% HTH in water. This mixture should be made just before use since the HTH can react with the ethanol. Fourteen grams of alcoholic HTH solution are used for each gram of VX. Agitate the decontamination mixture as the VX is added. Continue the agitation for a minimum of one hour. This reaction is reasonably exothermic and evolves substantial off gassing. The evolved reaction gases should be routed through a decontaminate filled scrubber before release through filtration systems. After completion of the one hour minimum agitation, 10% sodium hydroxide is added in a quantity equal to that necessary to assure that a pH of 12.5 is maintained for a period not less than 24 hours. Hold the material at a pH between 10 and 12 for a period not less than 90 days to ensure that a hazardous intermediate material is not formed (See Section VI). Scoop up all material and place in a DOT

approved container. Cover the contents of the with decontaminating solution as above. After sealing the exterior, decontaminate and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g., vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminant according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

If the alcoholic HTH mixture is not available, then the following decontaminants may be used instead and are listed in the order of preference: Decontaminating Agent (DS2), Supertropical Bleach Slurry (STB), and Sodium Hypochlorite.

Recommended Laboratory Procedures (For Quantities Less Than 50 Grams):

If the active chlorine of the Calcium Hypochlorite (HTH) is at least 55%, then 80 grams of a 10% slurry are required for each gram of VX. Proportionally more HTH is required if the chlorine activity of the HTH is lower than 55%. The mixture is agitated as the VX is added and the agitation is maintained for a minimum of one hour. If phasing of the VX/decon solution continues after 5 minutes, an amount of denatured ethanol equal to a 10 wt.% of the total agent/decon will be added to help miscibility. Place all material in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, decontaminate the exterior of the container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of according to Federal, State, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Note: Ethanol should be reduced to prevent the formation of a hazardous waste.

Upon completion of the one hour agitation the decon mixture will be adjusted to a pH between 10 and 11. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Waste Disposal Method: Open pit burning or burying of VX or items containing or contaminated with VX in any quantity is prohibited. The detoxified VX(using procedures above) can be thermally destroyed by in a EPA approved incinerator according to appropriate provisions of Federal, State, or local Resource Conservation and Recovery Act (RCRA) regulations.

Note: Some decontaminate solutions are hazardous waste according to RCRA regulations and must be disposed of according to those regulations.

Section VIII - Special Protection Information

Respiratory Protection

Concentration	Respiratory Protective Equipment
<0.00001 mg/m^3	A full face piece, chemical canister air-purifying protective mask will be on hand for escape. M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used. 
>0.00001 or = 0.02 mg/m^3	A NIOSH/MSHA approved pressure demand full face piece SCBA or supplied air respirators with escape air cylinder may be used. Alternatively, a full face piece, chemical canister air-purifying protective mask is acceptable for this purpose (See DA Pam 385-61 for determination of appropriate level.
>0.02 or unknown	NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble. (See DA Pam 385-61 for examples)

Ventilation: Local exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentrations to <0.00001 mg/m^3. Air emissions will meet local, state, and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) ±20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm ±20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent VX.

Other: Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

Protective Gloves: Butyl Rubber Glove M3 and M4 Norton, Chemical Protective Glove Set.

Eye Protection: At a minimum chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent VX is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP). Real-time, low-level monitors (with alarm) are required for VX operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling And Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the work day.

Other Precautions: Agent containers will be stored in a single containment system within a laboratory hood or in double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172.

Proper Shipping Name: Toxic liquids, organic, n.o.s.

DOT Hazard Class: 6.1, Packing Group I, Hazard Zone A.

DOT Hazard Class: 6.1, Packing Group I, Hazard Zone A.

DOT Label: Poison.

DOT Marking: Toxic liquids, organic, n.o.s. (O-ethel S-(2-diisopropylaminoethyl)methylphosphonothiolate) UN 2810, Inhalation Hazard.

DOT Placard: Poison.

Emergency Accident Precautions And Procedures: See Sections IV, VII, and VIII.

Precautions to be taken in transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

This page last reviewed on 29 August 2001

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Material Safety Data Sheet

Soman (GD)

Date: 14 September 1988
Revised: 29 September 1999

In the event of an emergency
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:
U.S. Army Soldier and Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Registry Numbers:
96-64-0, 50642-24-5

Chemical Name: Pinacolyl methyl phosphonofluoridate

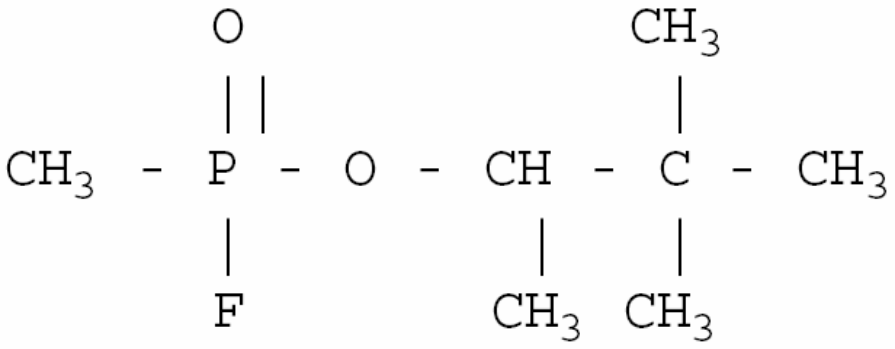
Alternate Chemical Names:
Phosphonofluoridic acid, methyl-,1,2,2-trimethylpropyl ester
O-Pinalcolyl methylphosphonofluoridate

Trade Name and Synonyms:
3,3 dimethyl-n-but-2-yl methylphosphonofluridate
1,2,2-Trimethylpropyl methylphosphonofluoridate
Methylpinacolyloxyfluorophosphine oxide
Pinacolyloxymethylphosphonyl fluoride
Pinacolyl methanefluorophosphonate
Methylfluoropinacolylphosphonate
Fluoromethylpinacolyloxyphosphine oxide

Methylpinacolyloxyphosphonyl fluoride
Pinacolyl methylfluorophosphonate
1,2,2-Trimethylpropoxyfluoromethylphosphine oxide
GD
EA 1210
Soman
Zoman
PFMP

Chemical Family: Fluorinated organophosphorus compound

Formula/Chemical Structure:
$C_7 H_{16} F O_2 P$



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0

Section II - Ingredients

Ingredients/Name: GD

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.00003 mg/m^3

Section III - Physical Data

Boiling Point @ 760 mm Hg: 388 °F (198 °C)

Vapor Pressure (mm Hg): 0.40 @ 25 °C

Vapor Density (Air = 1 STP): 6.29 @ 25 °C

Solubility (g/100g solvent): Slightly soluble in water; 3.4 @ 0 °C; 2.1 @ 20 °C. Soluble in sulfur mustard, gasoline, alcohols, fats, and oils.

Specific Gravity (H_20=1g/mL @ 25 °C): 1.0252

Freezing/Melting Point (°C): -42 °C

Liquid Density (g/cc): 1.0222 @ 25 °C

Volatility (mg/m3): 3900 @ 25 °C

Viscosity (CENTISTOKES): 3.098 @ 25 °C

Appearance and Odor: When pure, colorless liquid with a fruity odor. With impurities, amber or dark brown with oil of camphor odor.

Section IV - Fire and Explosion Data

Flashpoint: 121 °C (Open Cup Method)

Flammability Limits (% By Volume): Not Available

Lower Explosive Limit: Not Available

Upper Explosive Limit: Not Available

Extinguishing Media: Water mist, fog, and foam, CO_2. Avoid using extinguishing methods that will cause splashing or spreading of the GD.

Special Fire Fighting Procedures: GD will react with steam or water to produce toxic and corrosive vapors. All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving GD should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing GD, fire-fighting personnel should wear full fire-fighter protective clothing during chemical agent fire-fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where fire-fighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken

to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid GD or vapors can be fatal.

Unusual Fire and Explosion Hazards: Hydrogen produced by the corrosive vapors reacting with metals, concrete, etc., may be present.

Section V - Health Hazard Data

Airborne Exposure Limits (AEL): The permissible airborne exposure concentration for VX for an 8-hour workday of a 40-hour workweek is an 8-hour time weighted average (TWA) of 0.00003 mg/m^3. This value can be found in "DA Pam 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for GD.

GD is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

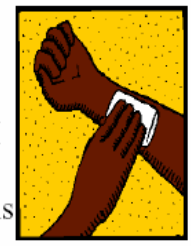
Effects of Overexposure: GD is a lethal cholinesterase inhibitor. Doses that are potentially life threatening may be only slightly larger than those producing least effects.

Route	*Form*	*Effect*	*Type*	*Dosage*
ocular	vapor	miosis	ECt50	<2 $mg\text{-}min/m^3$
Inhalation	vapor	runny nose	ECt50	<2 $mg\text{-}min/m^3$
Inhalation (15 l/min)	vapor	severe incapacitation	ICt50	<35 $mg\text{-}min/m^3$
Inhalation (15 l/min)	vapor	death	LCt50	<70 $mg\text{-}min/m^3$
Percutaneous	liquid	death	LD50	<350 mg/70 kg man

Effective dosages for vapor are estimated for exposure durations of 2-10 minutes.

Symptoms of overexposure may occur within minutes or hours, depending upon dose. They include: miosis (constriction of pupils) and visual effects, headaches and pressure sensation, runny nose and nasal congestion, salivation, tightness in the chest, nausea, vomiting, giddiness, anxiety, difficulty in thinking and sleeping, nightmares, muscle twitches, tremors, weakness, abdominal cramps, diarrhea, involuntary urination and defecation. With severe exposure symptoms progress to convulsions and respiratory failure.

Emergency and First Aid Procedures:



Inhalation: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, in coordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by a physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention **Immediately**.

Eye Contact: Immediately flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken **Immediately** to a medical treatment facility for observation.

Skin Contact: Don respiratory protective mask and remove contaminated clothing. **Immediately** wash contaminated skin with copious amounts of soap and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove excess decontaminant. Administer nerve agent antidote kit, Mark I, only if local sweating and muscular twitching symptoms are observed. Seek medical attention **Immediately**.

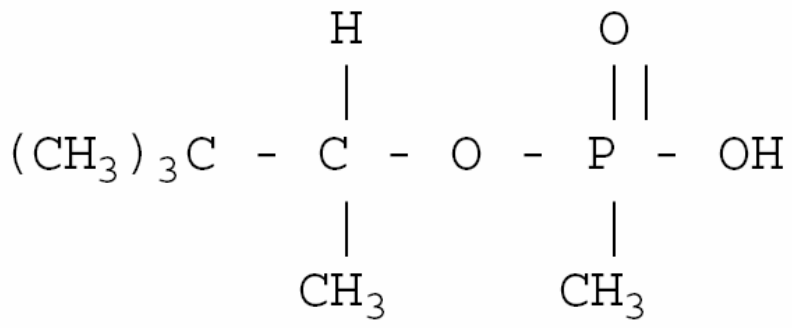
Ingestion: Do not induce vomiting. First symptoms are likely to be gastrointestinal. **Immediately** administer Nerve Agent Antidote Kit, Mark I. Seek medical attention **Immediately**.

Section VI - Reactivity Data

Stability: Stable in steel for 3 months at 65 ^{o}C.

Incompatibility: GD corrodes steel at the rate of 1 x 10^{-5} inch/month.

Hazardous Decomposition Products: GD will hydrolyze to form HF and the following formulation:



Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, And Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: If leaks or spills of GD occur, only personnel in full protective clothing will remain in the area (See Section VIII). In case of personnel contamination, see Section V for emergency and first aid instructions.

Recommended Field Procedures: Spills must be contained by covering with vermiculite, diatomaceous earth, clay, fine sand, sponges, and paper or cloth towels. Decontaminate with copious amounts of aqueous sodium hydroxide solution (a minimum 10 wt.%). Scoop up all material and place in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, decontaminate the exterior and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of material according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

If 10 wt.% aqueous sodium hydroxide is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontaminating Agent (DS2), Sodium Carbonate, and Supertropical Bleach Slurry (STB).

Recommended Laboratory Procedures: A minimum of 55 grams of decon solution is required per gram of GD. Decontaminant/agent solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour provided a single phase is obtained. At the end of the first hour, the pH should be checked and adjusted up to 11.5 with additional NaOH as required. An alternate solution for the decontamination of GD is 10% sodium carbonate in place of the 10% Sodium

Hydroxide solution above. Continue with 55 grams of decon per gram of GD. Agitate for one hour and allow to react for three hours. At the end of the third hour, adjust the pH to above 10. It is also permitted to substitute 5.25% sodium hypochlorite for the 10% sodium hydroxide solution above. Continue with 55 grams of decon per gram of GD. Agitate for one hour and allow to react for three hours then adjust the pH to above 10. Scoop up all material and clothing. Place all material in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, decontaminate the exterior of the container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of contents and decontaminate according to Federal, State, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Waste Disposal Method: Open pit burning or burying of GD or items containing or contaminated with GD in any quantity is prohibited. The detoxified GD (using procedures above) can be thermally destroyed by incineration in EPA approved incinerators according to appropriate provisions of Federal, state, and local Resource Conservation and Recovery Act (RCRA) Regulations.

Note: Some decontaminate solutions are hazardous wastes according to RCRA regulations and must be disposed of according to those regulations.

Section VIII - Special Protection Information

Concentration	Respiratory Protective Equipment
< 0.00003 mg/m^3	A full face piece, chemical canister, air-purifying protective mask will be on hand for escape. M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used. 

>0.00003 or = 0.06 mg/m^3	A NIOSH/MSHA approved pressure demand full face piece SCBA or supplied air respirators with escape air cylinder may be used. Alternatively, a full face piece, chemical canister air-purifying protective mask is acceptable for this purpose (See DA Pam 385-61 for determination of appropriate level).
>0.06 mg/m^3 or unknown	NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble (See DA Pam 385-61 for examples).

Ventilation:

Local exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentrations to < 0.00003 mg/m^3. Air emissions will meet local, state, and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) ±20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm ±20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent GD.

Other: Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

Protective Gloves: Butyl Rubber Glove M3 and M4 Norton, Chemical Protective Glove Set

Eye Protection: At a minimum chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab

animals.

Monitoring: Available monitoring equipment for agent GD is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for GD operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling and Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

Other Precautions: Agent containers will be stored in a single containment system within a laboratory hood or in a double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172

Proper Shipping Name: Toxic liquids, organic, n.o.s.

DOT Hazard Class: 6.1, Packing Group I, Hazard Zone B

DOT Label: Poison

DOT Marking: Toxic liquids, organic, n.o.s. (Pinacolyl methyl phosphonofluoridate) uN 2810, Inhalation Hazard

DOT Placard: Poison

Emergency Accident Precautions And Procedures: See Sections IV, VII, and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Addendum A

Additional Information For Thickened GD

Trade Name And Synonyms: Thickened GD, TGD

Trade Name And Synonyms for Thickener:
Acrylic acid butyl ester
Polymer with styrene
Butyl acrylate-styrene polymer
Butyl acrylate-styrene copolymer
N-Butyl acrylate-styrene polymer
Polymer with styrene acrylic acid butyl ester
2-Propenoic acid
Butyl ester
Polymer with ethenylbenzene
Styrene-butyl acrylate polymer
Acronal 4D
Acronal 290D
Acronal 295D
Acronal 320D
Mowilith DM60
Sokrate LX 75
OSH22097

Hazardous Ingredients: Styrene-butyl acrylate copolymer is used to thicken GD and is not known to be hazardous except in a finely-divided, powder form.

Physical Data: Essentially the same as GD.

Fire And Explosion Data: Same as GD. Thickener poses a slight fire hazard when exposed to heat or flame.

Health Hazard Data: Same as GD except for skin contact. For skin contact, don respiratory protective mask and remove contaminated clothing **Immediately**. **Immediately** scrape the TGD from the skin surface, then wash the contaminated surface with acetone. Administer Nerve Agent Antidote Mark I Kit, only if local sweating and muscular twitching symptoms are observed. Seek medical attention **Immediately**.

Spill, Leak, And Disposal Procedures: If spills or leaks of GD occur, follow the same procedures as those for GD, but dissolve TGD in acetone before introducing any decontaminating solution. Containment of TGD is generally not necessary. Spilled TGD can be carefully scraped off the contaminated surface and placed in a fully removable head drum with a high density, polyethylene lining. TGD can then be decontaminated, after it has been dissolved in acetone, using the same procedures used for GD. Contaminated surfaces should be treated with acetone, then decontaminated using the same procedures as those used for GD.

Special Protection Information: Same as GD.

Special Precautions: Same as GD with the following addition. Handling the TGD requires careful observation of the "stringers" (elastic, thread like attachments) formed when the agents are transferred or dispensed. These stringers must be broken cleanly before moving the contaminating device or dispensing device to another location, or unwanted contamination of a working surface will result. Avoid contact with strong oxidizers, excessive heat, sparks, or open flame.

Transportation Data: Same as GD.

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Material Safety Data Sheet

SARIN
Lethal Nerve Agent (GB)

Date: 22 September 1988
Revised: 29 September 1999

In the event of an emergency
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:
U.S. Army Soldier and Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Registry Numbers:
107-44-8, 50642-23-4

Chemical Name:
Isopropyl methylphosphonofluoridate

Alternate Chemical Names:
O-Isopropyl Methylphosphonofluoridate
Phosphonofluoridic acid, methyl-, isopropyl ester
Phosphonofluoridic acid, methyl-, 1-methylethyl ester

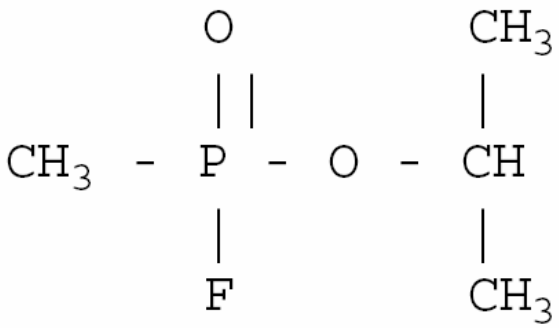
Trade Name And Synonyms:
Isopropyl ester of methylphosphonofluoridic acid

Methylisopropoxyfluorophosphine oxide
Isopropyl Methylfluorophosphonate
O-Isopropyl Methylisopropoxfluorophosphine oxide
Methylfluorophosphonic acid, isopropyl ester
Isopropoxymethylphosphonyl fluoride
Isopropyl methylfluorophosphate
Isopropoxymethylphosphoryl fluoride
GB
Sarin
Zarin

Chemical Family:
Fluorinated organophosphorous compound

Formula/Chemical Structure:

$C_4 H_{10} F O_2 P$



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0

Section II - Ingredients

Ingredients/Name: GB

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.0001 mg/m^3

Section III - Physical Data

Boiling Point @ 760 mm Hg: 316 °F (158 °C)

Vapor Pressure (mm Hg): 2.9 @ 25 °C

Vapor Density (Air = 1 STP): 4.83 @ 25 °C

Solubility: Miscible with water. Soluble in all organic solvents.

Specific Gravity (H_20=1g/mL): 1.0919 @ 25 °C

Freezing/Melting Point (°C): -56 °C

Liquid Density (g/cc): 1.0887 @ 25 °C
1.102 @ 20 °C

Volatility (mg/m^3): 22,000 @ 25 °C

Viscosity (CENTISTOKES): 1.283 @ 25 °C

Appearance and Odor: Colorless liquid. Odorless in pure form.

Section IV - Fire and Explosion Data

Flashpoint: Did not flash to 280 &degF (McCutchan - Young)

Flammability Limits (% By Volume): Not Applicable

Lower Explosive Limit: Not Applicable

Upper Explosive Limit: Not Applicable

Extinguishing Media: Water mist, fog, foam, CO_2. Avoid using extinguishing methods that will cause splashing or spreading of the GB.

Special Fire Fighting Procedures: GB will react with steam or water to produce toxic and corrosive vapors. All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving GB should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing GB, fire fighting personnel should wear full firefighter protective clothing during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with nerve agents must be avoided at all

times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid GB or vapors can be fatal.

Unusual Fire And Explosion Hazards: Hydrogen may be present.

Section V - Health Hazard Data

Airborne Exposure Limits (AEL): The permissible airborne exposure concentration for GB for an 8-hour workday of a 40-hour work week is an 8-hour time weighted average (TWA) of 0.0001 mg/m^3. This value can be found in "DA Pam 40-8,Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for GB.

GB is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

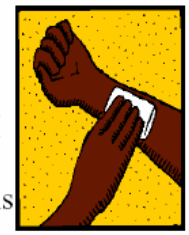
Effects Of Overexposure: GB is a lethal cholinesterase inhibitor. Doses which are potentially life-threatening may be only slightly larger than those producing least effects.

Route	*Form*	*Effect*	*Type*	*Dosage*
ocular	vapor	miosis	ECt50	<2 mg-min/m^3
Inhalation	vapor	runny nose	ECt50	<2 mg-min/m^3
Inhalation (15 l/min)	vapor	severe incapacitation	ICt50	35 mg-min/m^3
Inhalation (15 l/min)	vapor	death	LCt50	70 mg-min/m^3
Percutaneous	liquid	death	LD50	1700 mg/70 kg man

Effective dosages for vapor are estimated for exposure durations of 2-10 minutes.

Symptoms of overexposure may occur within minutes or hours, depending upon the dose. They include: miosis (constriction of pupils) and visual effects, headaches and pressure sensation, runny nose and nasal congestion, salivation, tightness in the chest, nausea, vomiting, giddiness, anxiety, difficulty in thinking, difficulty sleeping, nightmares, muscle twitches, tremors, weakness, abdominal cramps, diarrhea, involuntary urination and defecation. With severe exposure symptoms progress to convulsions and respiratory failure.

Emergency And First Aid Procedures:



Inhalation: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, in coordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by a physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention **Immediately**.

Eye Contact: Immediately flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken **Immediately** to a medical treatment facility for observation.

Skin Contact: Don respiratory protective mask and remove contaminated clothing. **Immediately** wash contaminated skin with copious amounts of soap and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove excess decontaminant. Administer nerve agent antidote kit, Mark I, only if local sweating and muscular twitching symptoms are observed. Seek medical attention **Immediately.**

Ingestion: Do not induce vomiting. First symptoms are likely to be gastrointestinal. **Immediately** administer Nerve Agent Antidote Kit, Mark I. Seek medical attention **Immediately.**

Section VI - Reactivity Data

Stability: Stable when pure. Plant grade material stablized with tri-n-butylamine can be stored in steel containers for long periods of time at temperatures up to 70 °C, but unstablized material tends to build-up pressure within a few weeks.

Incompatibility: Attacks tin, magnesium, cadmium plated steel, and some aluminum. Slightly attacks copper, brass, and lead; practically no attack on 1020 steels, Inconel and K-monel.

Hazardous Decomposition Products: Hydrolyzes to form HF under acid conditions and isopropyl alcohol and polymers under basic conditions.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, and Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: If leaks or spills of GB occur, only personnel in full protective clothing will remain in the area (See Section VIII). In case of personnel contamination see Section V for emergency and first aid instructions.

Recommended Field Procedures: Spills must be contained by covering with vermiculite, diatomaceous earth, clay, fine sand, sponges, and paper, or cloth towels. Decontaminate with copious amounts of aqueous sodium hydroxide solution (a minimum 10 wt.%). Scoop up all material and place in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, the exterior will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g., vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminate according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

If 10 wt.% aqueous sodium hydroxide is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontaminating Agent (DS2), Sodium Carbonate, and Supertropical Bleach Slurry (STB).

Recommended Laboratory Procedures: A minimum of 56 grams of decon solution is required for each gram of GB. Decontaminant and agent solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour. At the end of one hour, the resulting solution should be adjusted to a pH greater than 11.5. If the pH is below 11.5, NaOH should be added until a pH above 11.5 can be maintained for 60 minutes. An alternate solution for the decontamination of GB is 10 wt.% sodium carbonate in place of the 10% sodium hydroxide solution above. Continue with 56 grams of decon for each gram of agent. Agitate for one hour but allow three hours for the reaction. The final pH should be adjusted to above zero. It is also permitted to substitute 5.25% sodium hypochlorite or 25 wt.% Monoethylamine (MEA) for the 10% sodium hydroxide solution above. MEA must be completely dissolved in water before addition of the agent. Continue with 56 grams of decon for each gram of GB and provide agitation for one hour. Continue with same ratios and time stipulations. Scoop up all material and clothing. Place all material in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, decontaminate the exterior of the container and label according to EPA and DOT regulations. All

leaking containers will be over packed with sorbent placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminate according to Federal, State, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Waste Disposal Method: Open pit burning or burying of GB or items containing or contaminated with GB in any quantity is prohibited. The detoxified GB (using procedures above) can be thermally destroyed by incineration in EPA approved incinerators according to appropriate provisions of Federal, state and local Resource Conservation and Recovery Act (RCRA) Regulations.

Note: Some decontaminate solutions are hazardous waste according to RCRA regulations and must be disposed of according to those regulations.

Section VIII - Special Protection Information

Respiratory Protection:

Concentration	Respiratory Protective Equipment
< 0.0001 mg/m^3	A full face piece, chemical canister, air-purifying protective mask will be on hand for escape. M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used. 
>0.0001 or = 0.2 mg/m^3	A NIOSH/MSHA approved pressure demand full face piece SCBA or supplied air respirators with escape air cylinder may be used. Alternatively, a full face piece, chemical canister air-purifying protective mask is acceptable for this purpose (See DA Pam 385-61 for determination of appropriate level)

>0.2 mg/m^3 or unknown	NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble (See DA Pam 385-61 for examples).

Ventilation:

Local exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentrations to < 0.0001 mg/m^3. Air emissions will meet local, state, and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) ±20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm ±20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent GB.

Other: Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

Protective Gloves: Butyl Rubber Glove M3 and M4 Norton, Chemical Protective Glove Set

Eye Protection: At a minimum chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves, and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent GB is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for GB operations. In

their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling And Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the work day.

Other Precautions: Agent containers will be stored in a single containment system within a laboratory hood or in a double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172

Proper Shipping Name: Toxic liquids, organic, n.o.s.

DOT Hazard Class: 6.1, Packing Group I, Hazard Zone A

DOT Label: Poison

DOT Marking: Toxic liquids, organic, n.o.s. (Isopropyl methylphosphonofluoridate) UN 2810, Inhalation Hazard

DOT Placard: Poison

Emergency Accident Precautions And Procedures: See Sections IV, VII, and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be

escorted in accordance with AR 740-32.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

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[Products] [Programs] [Services] [Facilities] [Bus.Ops.] [Hooah]

Material Safety Data Sheet

Tabun (GA)

Date: 22 September 1988
Revised: 28 September 1999

In the event of an emergency:
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:
U.S. Army Soldier and Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Registry Numbers: 77-81-6

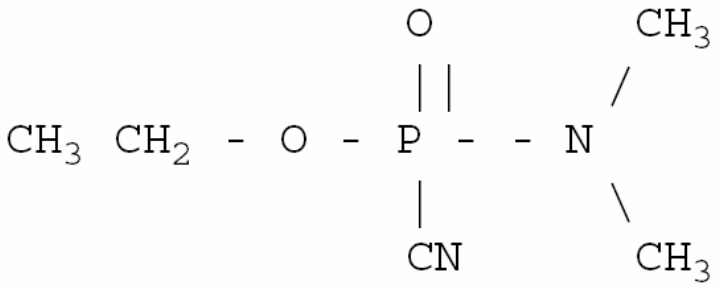
Chemical Name: Ethyl N,N-dimethylphosphoramidocyanidate

Trade Name and Synonyms:
Ethyl dimethylphosphoramidocyanidate
Dimethylaminoethoxy-cyanophosphine oxide
Dimethylamidoethoxyphosphoryl cyanide
Ethyldimethylaminocyanophosphonate
Ethyl ester of dimethylphosphoroamidocyanidic acid
Ethyl phosphorodimethylamidocyanidate
GA
EA1205
Tabun

Chemical Family: Organophosphorus compound

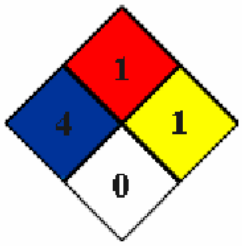
Formula/Chemical Structure:

$C_5 H_{11} N_2 O_2 P$



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0



Section II - Ingredients

Ingredients/Name: GA

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.0001 mg/m^3

Section III - Physical Data

Boiling Point @ 760 mm Hg: 478 °F (248 °C)

Vapor Pressure: 0.057 mm Hg @ 25 °C

Vapor Density (Air = 1 STP): 5.59 @25 °C

Solubility (g/100g solvent): Slightly soluble in water, 9.8 @ 0 °C; 7.2 @ 20 °C. Readily soluble in organic solvents.

Specific Gravity (H_20=1g/mL@25 °C): 1.076

Freezing/Melting Point (°C): -50 °C

Liquid Density (g/cc): 1.073 @ 25 °C

Volatility (mg/m^3): 490 @ 25 °C

Viscosity (CENTISTOKES): 2.18 @ 25 °C

Appearance and Odor: Colorless to brown liquid, faintly fruity odor. Odorless in pure form.

Section IV - Fire And Explosion Data

Flashpoint: 78 °C (Closed Cup Method)

Flammability Limits (% By Volume): Not Available

Lower Explosive Limit: Not Available

Upper Explosive Limit: Not Available

Extinguishing Media: Water mist, fog, and foam, CO_2. Avoid using extinguishing methods that will cause splashing or spreading of the GA.

Special Fire Fighting Procedures: GA will react with steam or water to produce toxic and corrosive vapors. All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving GA should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing GA, fire-fighting personnel should wear full fire-fighter protective clothing during chemical agent fire-fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where fire-fighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII). Do not breathe fumes. Skin contact with nerve agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with liquid GA or vapors can be fatal.

Unusual Fire and Explosion Hazards: Fires involving this chemical may result in the formation of hydrogen cyanide.

Section V - Health Hazard Data

Airborne Exposure Limits (AEL): The permissible airborne exposure concentration for GA for an 8-hour workday of a 40-hour workweek is an 8-hour time weighted average (TWA) of 0.0001 mg/m^3. This value can be found in "DA Pam 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for GA.

GA is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

Effects of Overexposure: GA is a lethal cholinesterase inhibitor similar inaction to GB. Although only about half as toxic as GB by inhalation, GA in low concentrations is more irritating to the eyes than GB. The number and severity of symptoms that appear are dependent on the quantity and rate of

entry of the nerve agent introduced into the body. (Very small skin dosages sometimes cause local sweating and tremors with few other effects.) Individuals poisoned by GA display approximately the same sequence of symptoms' despite the route by which the poison enters the body (whether by inhalation, absorption, or ingestion). These symptoms, in normal order of appearance, are: runny nose; tightness of the chest; dimness of vision and pin pointing of the eye pupils; difficulty in breathing; drooling and excessive sweating; nausea; vomiting, cramps, and involuntary defecation and urination; twitching, jerking, and staggering; and headache, confusion, drowsiness, coma, and convulsions. These symptoms are followed by cessation of breathing and death.

Onset Time of Symptoms: Symptoms appear much more slowly from a skin dosage than from a respiratory dosage. Although skin absorption great enough to cause death may occur in 1 to 2 minutes, death may be delayed for 1 to 2 hours. Respiratory lethal dosages kill in 1 to 10 minutes, and liquid in the eye kills almost as rapidly.

Median Lethal Dosage, Animals:

LD50 (monkey, percutaneous) = 9.3 mg/kg (shaved skin)

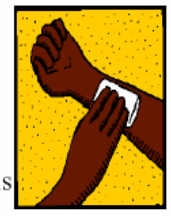
LCt50 (monkey, inhalation) = 187 mg-min/m(t = 10)

Median Lethal Dosage, Man:

LCt50 (man, inhalation) = 135 mg-min/m[(t = 0.5-2 min) at RMV (Respiratory Minute Volume) of 15 l/min];

200 mg-min/m[T at RMV of 10 l/min]

Emergency and First Aid Procedures:



Inhalation: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, in coordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by a physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention **Immediately**.

Eye Contact: Immediately flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken **Immediately** to a medical treatment facility for observation.

Skin Contact: Don respiratory protective mask and remove contaminated clothing. **Immediately** wash contaminated skin with copious amounts of soap

and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove excess decontaminant. Administer nerve agent antidote kit, Mark I, only if local sweating and muscular twitching symptoms are observed. Seek medical attention **Immediately.**

Ingestion: Do not induce vomiting. First symptoms are likely to be gastrointestinal. **Immediately** administer Nerve Agent Antidote Kit, Mark I. Seek medical attention **Immediately.**

Section VI - Reactivity Data

Stability: Compound is stable in steel for several years.

Incompatibility: Not Available.

Hazardous Decomposition Products: Decomposes within 3 months at 65 °C. Complete decomposition in 195 minutes at 150 °C. May produce hydrogen cyanide (HCN), oxides of nitrogen, oxides of phosphorus, and carbon monoxide.

Hazardous Polymerization: Not available.

Section VII - Spill, Leak, And Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: If leaks or spills of GA occur, only personnel in full protective clothing will remain in the area (See Section VIII). In case of personnel contamination, see Section V for emergency and first aid instructions.

Recommended Field Procedures: Spills must be contained by covering with vermiculite, diatomaceous earth, clay, fine sand, sponges, and paper or cloth towels. Decontaminate with copious amounts of aqueous sodium hydroxide solution (a minimum 10 wt.%). Scoop up all material and place in a DOT approved container. The decontaminant solution must be treated with excess bleach to destroy the HCN formed during the hydrolysis. Cover the contents with decontaminating solution as above. After sealing, decontaminate the exterior and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of material according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

If 10 wt.% aqueous sodium hydroxide is not available, then the following decontaminants may be used instead and are listed in the order of preference: Decontaminating Agent (DS2), Sodium Carbonate, and Supertropical Bleach Slurry (STB).

Recommended Laboratory Procedures:

A minimum of 56 grams of decon solution is required for each gram of GA. The decontamination solution is agitated while GA is added and the agitation is maintained for at least one hour. The resulting solution is allowed to react for 24 hours. At the end of 24 hours, the solution must be titrated to a pH between 10 and 12. After completion of the 24-hour period, the decontamination solution must be treated with excess bleach (2.5 mole OCl/mole GA) to destroy the CN formed during the hydrolysis.

Scoop up all material and clothing. Place all material in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, decontaminate the exterior of the container and label according to EPA and DOT regulations. All leaking containers will be over packed with sorbent placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of contents and decontaminant according to Federal, State, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Waste Disposal Method: Open pit burning or burying of GA or items containing or contaminated with GA in any quantity is prohibited. The detoxified GA (using procedures above) can be thermally destroyed by incineration in EPA approved incinerators according to appropriate provisions of Federal, state, and local Resource Conservation and Recovery Act (RCRA) Regulations.

Note: Some decontaminant solutions are hazardous wastes according to RCRA regulations and must be disposed of according to those regulations.

Section VIII - Special Protection Information

Respiratory Protection

Concentration

<0.0001 mg/m^3

Respiratory Protective Equipment

A full face piece, chemical canister air-purifying protective mask will be on hand for escape. M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used.

Concentration

>0.0001 or = 0.02 mg/m^3

Respiratory Protective Equipment

A NIOSH/MSHA approved pressure demand full face piece SCBA or supplied air respirators with escape air cylinder may be used. Alternatively, a full face piece, chemical canister air-purifying protective mask is acceptable for this purpose (See DA Pam 385-61 for determination of appropriate level).

Concentration

>0.02 mg/m^3 or unknown

Respiratory Protective Equipment

NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble. (See DA Pam 385-61 for examples).

Ventilation:

Local exhaust: Mandatory. Must be filtered or scrubbed to limit exit concentrations to >0.0001 mg/m^3. Air emissions will meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) ±20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm ±20%. Laboratory hoods will be located such that cross-drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke-producing devices will be performed in assessing the ability of the hood to contain agent GA.

Other: Recirculation or exhaust air from chemical areas is prohibited. No connection between chemical areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested at least semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hood face.

Protective Gloves: Butyl Rubber Glove M3 and M4 Norton, Chemical Protective Glove Set.

Eye Protection: At a minimum chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats and gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent GA is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and the Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for GA operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling and Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

Other Precautions: Agent containers will be stored in a single containment system within a laboratory hood or in a double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172

Proper Shipping Name: Toxic liquids, organic, n.o.s.

DOt Hazard Class: 6.1, Packing Group I, Hazard Zone B

DOT Label: Poison

DOT Marking: Toxic liquids, organic, n.o.s. (Ethyl dimethylphosphoramidocyanidate) UN 2810, Inhalation Hazard

DOT Placard: Poison

Emergency Accident Precautions And Procedures: See Sections IV, VII, and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

This page last reviewed on 30 August 2001

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Material Safety Data Sheet

Distilled Mustard (HD)

Date: 22 September 1988
Revised: 13 August 2001

In the event of an emergency:
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:
U.S. Army Soldier and Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Numbers 505-60-2, 39472-40-7, 68157-62-0

Chemical Name: Bis-(2-chloroethyl)sulfide

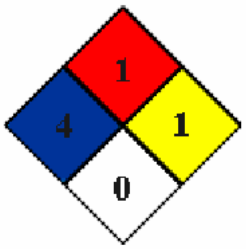
Trade name and synonyms:
H; HD; HS
Mustard Gas
Sulfur mustard; Sulphur mustard gas
Sulfide, bis (2-chloroethyl)
Bis(beta-chloroethyl)sulfide
1,1'-thiobis(2-chloroethane)
1-chloro-2(beta-chloroethylthio)ethane
Beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfideBeta, beta'-dichloroethyl sulfide
Iprit
S-Lost; S-yperite; Schewefel-lost
Senfgas

Yellow Cross Liquid
Yperite;Y
EA 1033

Chemical Family: Chlorinated sulfur compound

Formula/Chemical Structure:
C4 H8 C12 S

Cl CH2 CH2--S--CH2 CH2 Cl



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0

Section II - Ingredients

Ingredients/Name: Sulfur Mustard

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.003mg/m^3

Section III - Physical Data

Boiling Point °F (°C): Calculated 423.5 °F (217.5 °C) (decomposed)

Vapor Pressure (mm Hg):

0.069 @ 20 °C
0.11 @ 25 °C

Vapor Density (Air = 1): 5.5

Solubility (g/100g solvent): Negligible in water (0.92 @ 22 °C). Soluble in fats and oils, gasoline, kerosene, acetone, carbon tetrachloride, alcohol, tetrachloroethane, ethylbenzoate, and ether. Miscible with the organophosphorus nerve agents.

Specific Gravity (H_20=1): 1.27 @ 25 °C

Freezing/Melting Point (°C): 14.45

Liquid Density (g/mL):

1.274 g/mL @ 20 °C
1.268 g/mL @ 25 °C

Volatility (mg/m^3):

600 @ 20 °C
910 @ 25 °C

Viscosity (Centipoise): 5.175 @ 20 °C

Molecular Weight (g/mol): 159.08

Appearance and Odor: Normally amber to black colored liquid with garlic or horseradish odor. Water clear if pure. The odor threshold for HD is 0.6 mg/m^3 (0.0006 mg/L).

Section IV - Fire and Explosion Data

Flashpoint: 105 °C (Can be ignited by large explosive charges)

Flammability Limits (% by volume): Unknown

Extinguishing Media: Water, fog, foam, CO_2. Avoid use of extinguishing methods that will cause splashing or spreading of HD.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving HD should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, firefighting personnel should wear full firefighter protective clothing (flame resistant) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes, they will wear appropriate levels of protective clothing (See Section VIII). Do not breathe fumes. Skin contact with agent must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to ensure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with the agent, liquid or vapor, can be fatal.

Section V - Health Hazard Data

Airborne Exposure Limit (AEL): The AEL for HD is 0.003 mg/m^3 as found in "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT." To date, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for HD.

Effects of Overexposure: HD is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues which are especially sensitive. The rate of detoxification of HD in the body is very slow and repeated exposures produce a cumulative effect. HD is a human carcinogen as cited by the International Agency for Research on Cancer (IARC).

Median doses of HD in man are:
LD50 (skin, liquid) = 100 mg/kg
ICt50 (skin, vapor) = 2000 mg-min/m^3 at 70 - 80 °F (humid environment)

= 1000 mg-min/m^3 at 90 °F (dry environment)
ICt50 (eyes, vapor) = 200 mg-min/m^3
ICt50 (inhalation) = 1500 mg-min/m^3
LCt50 (skin, vapor) = 10,000 mg-mmin/m^3
LD50 (oral) = 0.7 mg/kg

Acute Physiological Action of HD is Classified as Local and Systemic.

Local Actions: HD effects both the eyes and the skin. Skin damage occurs after percutaneous absorption. Being lipid soluble, HD can be absorbed into all organs. Skin penetration is rapid without skin irritation. Swelling (blisters) and reddening (erythema) of the skin occurs after a latency period of 4-24 hours following the exposure, depending on degree of exposure and individual sensitivity. The skin healing process is very slow. Tender skin, mucous membrane and perspiration-covered skin is more sensitive to the effects of HD. HD's effect on the skin, however, is less than on the eyes. Local action on the eyes produces severe necrotic damage and loss of eyesight. Exposure of eyes to HD vapor or aerosol produces lacrimation, photophobia, and inflammation of the conjunctiva and cornea.

Systemic Actions: Occurs primarily through inhalation and ingestion. The HD vapor or aerosol is less toxic to the skin or eyes than the liquid form. When inhaled, the upper respiratory tract (nose, throat, trachea) is inflamed after a few hours latency period, accompanied by sneezing, coughing, and bronchitis, loss of appetite, diarrhea, fever, and apathy. Exposure to nearly lethal doses of HD can produce injury to bone marrow, lymph nodes, and spleen as shown by a drop in white blood cell count, thus resulting in increased susceptibility to local and systemic infections. Ingestion of HD will produce severe stomach pains, vomiting, and bloody stools after a 15-20 minute latency period.

Chronic Exposure: HD can cause sensitization, chronic lung impairment,(cough, shortness of breath, chest pain), cancer of the mouth, throat, respiratory tract and skin, and leukemia. It may also cause birth defects.

Emergency and First Aid Procedures:

Inhalation: Hold breath until respiratory protective mask is donned. Remove from the source **Immediately**. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention **Immediately**.

Eye Contact: Speed in decontaminating the eyes is absolutely essential. Remove the person from the liquid source, flush the eyes **Immediately** with water for at least 15 minutes by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the patient to a medical facility **Immediately**.

Skin Contact: Don respiratory protective mask. Remove the victim from agent sources **Immediately**. Immediately wash skin and clothes with 5% solution of sodium hypochlorite or liquid household bleach within one minute. Cut and

remove contaminated clothing, flush contaminated skin area again with 5% sodium hypochlorite solution, then wash contaminated skin area with soap and water. Seek medical attention **Immediately**.

Ingestion: Do not induce vomiting. Give victim milk to drink. Seek medical attention **Immediately**.

Section VI - Reactivity Data

Stability: Stable at ambient temperatures. Decomposition temperature is 100-351 °F (149-117 °C). Mustard is a persistent agent depending on pH and moisture and has been known to remain active for up to three years in soil.

Incompatibility: Rapidly corrosive to brass @ 65 °C. Will corrode steel at a rate of 0.0001 in. of steel per month @ 65 °C.

Hazardous Decomposition: Mustard will hydrolyze to form HCl and thiodiglycol.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, and Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: Only personnel in full protective clothing (See Section VIII) will be allowed in an area where HD is spilled. See Section V for emergency and first aid instructions.

Recommended Field Procedures: The HD should be contained using vermiculite,diatomaceous earth, clay, or fine sand and neutralized as soon as possible using copious amounts of 5.25% sodium hypochlorite solution. Scoop up all material and place in an approved DOT container. Cover the contents with decontaminating solution as above. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII). If 5.25% sodium hypochlorite solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Calcium Hypochlorite, contamination Solution No. 2 (DS2), and Super Tropical Bleach Slurry (STB).

Warning: Pure, undiluted calcium hypochlorite (HTH) will burn on contact with liquid HD.

Recommended Laboratory Procedures:

Decontamination solution for each gram of HD. Allow 24 hours for decontamination to take place. Agitate solution at least one hour. Agitation is not necessary after the first hour. Testing for presence of active chorine by use of acidic potassium iodide solution to give free iodine color. Adjust the resulting solution pH to between 10 and 11.

Place three millileters (ml) of decontaminated solution in a test tube. Add several crystals of potassium iodine and swirl to dissolve. Add 3 ml of 50 wt.% sulfuric acid:water and swirl. IMMEDIATE iodine color shows the presence of active chlorine. If negative, add additional decontaminant to the decontamination solution, wait two hours, and test again for active chlorine. This works for either 5.5% sodium hypochlorite or 10% calcium hypochlorite decontamination solution.

Scoop up all materials and clothing and place in an approved DOT container. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Section VIII).

Note: Surfaces contaminated with HD, then rinsed and decontaminated may evolve sufficient HD vapor to produce a physiological response. HD on laboratory glassware may be oxidized by its vigorous reaction with concentrated nitric acid.

Waste Disposal Method: Open pit burning or burying of HD or items containing or contaminated with HD in any quantity is prohibited. Decontamination of waste or excess material shall be accomplished according to the procedures outlined above and can be destroyed by incineration in EPA approved incinerators according to appropriate provisions of Federal, State, and local Resource Conservation Recovery Act (RCRA) regulations.

Note: Some decontaminant solutions are hazardous waste according to RCRA regulations and must be disposed of according to those regulations.

Section VIII - Special Protection Information

Respiratory Protection:

Concentration

<= 0.003 mg/m^3 as an 8-hr TWA

Respiratory Protective Equipment

Protective mask not required to be worn provided that:

(a) Monitoring will be conducted to confirm that engineering controls are properly maintaining concentrations <= 0.003 mg/m^3 as an 8-hr TWA.

(b) M40-series mask is available for emergency escape purposes.

(c) Exposure has been limited to the extent practicable by engineering controls (remote operations, ventilation, and process isolation) and work practices.

If these conditions are not met, then follow the guidance for >=0.003 mg/m^3 as an 8-hr TWA.

Concentration

>= 0.003 mg/m^3 as an 8-hr TWA

Respiratory Protective Equipment

NIOSH/MSHA approved, pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble. (See DA Pam 386-61 for examples).

Ventilation

Local Exhaust: Mandatory. Must be filtered or scrubbed. Air emissions shall meet local, state, and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) ±20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm ±20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in assessing the ability of the hood to contain agent HD.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hoods.

Protective Gloves: Butyl Rubber gloves M3 and M4 Norton, Chemical Protective Glove Set.

Eye Protection: As a minimum, chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves, and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent HD is the M8/M9 detector paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), CAM-M1, Hydrogen Flame Photometric Emission Detector

(HYFED), the Miniature Chemical Agent Monitor (MINICAM), and Real Time Analytical Platform (RTAP). Real-time, low-level monitors (with alarm) are required for HD operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling and Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the work day.

Other Precautions: HD should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent containers will be stored in a single containment system within a laboratory hood or in a double-containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to HD Agents H, HD, and HT."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172

Proper Shipping Name: Toxic liquids, n.o.s.

DOT Hazard Class: 6.1, Packing Group I, Hazard Zone B

DOT Label: Poison

DOT Marking: Toxic liquids, n.o.s. Bis-(2-chloroethyl) sulfide UN 2810, Inhalation Hazard

DOT Placard: Poison

Emergency Accident Precautions and Procedures: See Sections IV, VII, and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be

escorted in accordance with AR 740-32.

The Edgewood Chemical Biological Center (ECBC), Department of the Army, believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Addendum A

Additional Information For Thickened HD

Trade Name and Synonyms: Thickened HD, THD

Trade Name and Synonyms for Thickener:
Acrylic acid butyl ester
Polymer with styrene
Butyl acrylate-styrene polymer
Butyl acrylate-styrene copolymer
N-Butyl acrylate-styrene polymer
Polymer with styrene acrylic acid butyl ester
2-Propenoic acid
Butyl ester
Polymer with ethenylbenzene
Acronal 4D
Acronal 290D
Acronal 295D
Mowilith DM60
Sokrate LX 75
OSH22097

Hazardous Ingredients: Styrene-butyl acrylate copolymer is used to thicken HD and is not known to be hazardous except in a finely-divided, powder form.

Physical Data: Essentially the same as HD.

Fire and Explosion Data: Same as HD and slight fire hazard when exposed to heat or flame.

Health Hazard Data: Same as HD except for skin contact. For skin contact, don respiratory protective mask and remove contaminated clothing IMMEDIATELY. IMMEDIATELY scrape the HD from the skin surface, then wash the contaminated surface with acetone. Seek medical attention IMMEDIATELY.

Spill, Leak, and Disposal Procedures: If spills or leaks of HD occur, follow the same procedures as those for HD, but dissolve THD in acetone before introducing any decontaminating solution. Containment of THD is generally not necessary. Spilled THD can be carefully scraped off the contaminated surface and placed in a fully removable head drum with a high density, polyethylene lining. THD can then be decontaminated, after it has been dissolved in acetone, using the same procedures used for HD. Contaminated

surfaces should be treated with acetone, then decontaminated using the same procedures as those used for HD.

Note: Surfaces contaminated with THD and then rinse-decontaminated may evolve sufficient HD vapor to produce a physiological response.

Special Protection Information: Same as HD.

Special Precautions: Same as HD with the following addition. Handling the THD requires careful observation of the "stringers" (elastic, thread like attachments) formed when the agents are transferred or dispensed. These stringers must be broken cleanly before moving the contaminating device or dispensing device to another location, or unwanted contamination of a working surface will result. Avoid contact with strong oxidizers, excessive heat, sparks, or open flame.

Transportation Data: Same as HD.

This page last reviewed on 29 August 2001

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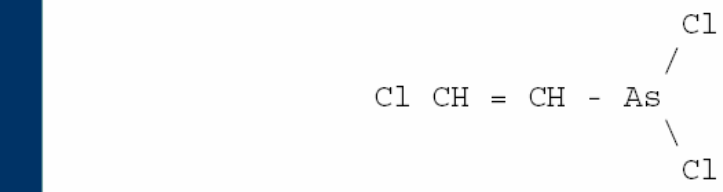
Chemical Family: Arsenical (vesicant)

Formula/Chemical Structure:

$C_2 H_2 As C_{13}$



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1
Special - 0

Section II - Ingredients

Ingredients/Name: Lewisite

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.003 mg/m^3 (This is a ceiling value)

Section III - Physical Data

Boiling Point °F (°C): Calculated 374 °F (190 °C)

Vapor Pressure (mm Hg): 0.22 @ 20 °C 0.35 @ 25 °C

Vapor Density (Air=1): 7.1

Solubility (g/100g solvent): Insoluble in water and dilute mineral acids. Soluble in organic solvents, oils and alcohol.

Specific Gravity (H_20=1): 1.891 @ 20 °C

Freezing/Melting Point (°C): -18.2 to 0.1 (Depending on purity)

Liquid Density (g/mL): 1.888 @ 20 °C

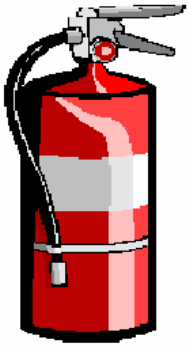
Volatility (mg/m^3): 2,500 @ 20 °C

Viscosity (Centipoise): 2.257 @ 20 °C

Molecular Weight (g/mol): 207.32

Appearance And Odor: Pure Lewisite is a colorless oily liquid. "War gas" is amber to dark brown liquid. A characteristic odor is usually geranium-like; very little odor when pure.

Section IV - Fire and Explosion Data



Flashpoint: Does not flash

Flammability Limits (% by volume): Not Applicable

Extinguishing Media: Water, fog, foam, CO_2. Avoid use of extinguishing methods that will cause splashing or spreading of L.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving L should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during chemical agent fire-fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with the agent liquid or vapor can be fatal.

Unusual Fire and Explosion Hazards: None known

Section V - Health Hazard Data

Airborne Exposure Limit (AEL): The permissible airborne exposure concentration of L for an 8-hour workday or a 40-hour workweek is an 8-hour time weighted average (TWA) of 0.003 mg/m^3 as a ceiling value. A ceiling value may not be exceeded at any time. The ceiling value for Lewisite is based upon the present technologically feasible detection limits of 0.003 mg/m^3. This value can be found in "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard H, HD, and HT." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated permissible exposure concentration for L.

Effects Of Overexposure: L is a vesicant (blister agent), also, it acts as a systemic poison, causing pulmonary edema, diarrhea, restlessness, weakness, subnormal temperature, and low blood pressure. In order of severity and appearance of symptoms, it is a blister agent, a toxic lung irritant, absorbed in tissues, and a systemic poison. When inhaled in high concentrations, L may be fatal in as short a time as 10 minutes. L is not detoxified by the body. Common routes of entry into the body are ocular, percutaneous, and inhalation.

Lewisite is generally considered a suspect carcinogen because of its arsenic content.

Toxicological Data:

Man:

LCt50 (inhalation, man) = 1200 - 1500 mg min/m^3
LCt50 (skin vapor exposure, man) = 100,000 mg min/m^3
LDLO (skin, human) = 20 mg/kg
LCt50 (skin, man): >1500 mg/min^3. L irritates eyes and skin and gives warning of its presence. Minimum effective dose (ED min) = 200 mg/m^3 (30 min).
ICt50 (eyes, man): <300 mg min/m^3.

Animal:

LD50 (oral, rat) = 50 mg/kg
LD50 (subcutaneous, rat) = 1 mg/kg
LCtLO (inhalation, mouse) = 150 mg/m^3 10m
LD50 (skin, dog = 15 mg/kg)
LD50 (skin, rabbit) = 6 mg/kg
LD50 (subcutaneous, rabbit) = 2 mg/kg
LD50 (intravenous, rabbit) = 2 mg/kg
LD50 (skin, guinea pig) = 12 mg/kg
LD50 (subcutaneous, guinea pig) = 1 mg/kg
LCt50 (inhalation, rat) = 1500 mg min/m^3 (9 min)
LD50 (vapor skin, rat) = 20,000 mg min m 25 min)
LD50 (skin, rat) = 15 - 24 mg/kg
LD50 (ip, dog) = 2 mg/kg

Acute Exposure:

Eyes: Severe damage. Instant pain, conjunctivitis and blepharospasm leading to closure of eyelids, followed by corneal scarring and iritis. Mild exposure produces reversible eye damage if decontaminated instantly. More permanent injury or blindness is possible within one minute of exposure.

Skin: Immediate stinging pain increasing in severity with time. Erythema (skin reddening) appears within 30 minutes after exposure accompanied by pain with itching and irritation for 24 hours. Blisters appear within 12 hours after exposure with more pain that diminishes after 2-3 days. Skin burns are much

deeper than with HD. Tender skin, mucous membrane, and perspiration-covered skin are more sensitive to the effects of L. This, however, is counteracted by L's hydrolysis by moisture, producing less vesicant and higher vapor pressure product.

Respiratory Tract: Irritating to nasal passages and produces a burning sensation followed by profuse nasal secretions and violent sneezing. Prolonged exposure causes coughing and production of large quantities of froth mucus. In experimental animals, injury to respiratory tracts, due to vapor exposure is similar to mustards; however, edema of the lung is more marked and frequently accompanied by pleural fluid.

Systemic Effects: L on the skin, and inhaled vapor, cause systemic poisoning. A manifestation of this is a change in capillary permeability, which permit's loss of sufficient fluid from the bloodstream to cause hemoconcentration, shock and death. In nonfatal cases, hemolysis of erythrocytes has occurred with a resultant hemolytic anemia. The excretion of oxidized products into the bile by the liver produces focal necrosis of that organ, necrosis of the mucosa of the biliary passages with periobiliary hemorrhages, and some injury to the intestinal mucosa. Acute systematic poisoning from large skin burns cause's pulmonary edema, diarrhea restlessness, weakness, subnormal temperature, and low blood pressure in animals.

Chronic Exposure: Lewisite can cause sensitization and chronic lung impairment. Also, by comparison to agent mustard and arsenical compounds, it can be considered as a suspected human carcinogen.

Emergency And First Aid Procedures:

Inhalation: Hold breath until respiratory protective mask is donned. Remove from the source **Immediately**. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention **Immediately**.

Eye Contact: Speed in decontaminating the eyes is absolutely essential. Remove the person from the liquid source, flush the eyes **Immediately** with water for at least 15 minutes by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the patient to a medical facility **Immediately.**

Skin Contact: Don respiratory protective mask. Remove the victim from agent sources immediately. **Immediately** wash skin and clothes with 5% solution of sodium hypochlorite or liquid household bleach within one minute. Cut and remove contaminated clothing, flush contaminated skin area again with 5% sodium hypochlorite solution, then wash contaminated skin area with soap and

water. Seek medical attention **Immediately**.

Ingestion: Do not induce vomiting. Give victim milk to drink. Seek medical attention **Immediately.**

Section VI - Reactivity Data

Stability: Stable in steel or glass containers at temperatures below 50 °C

Incompatibility: Corrosive to steel at a rate of 1 x 10^{-5} to 5 x 10^{-5} in/month at 65 °C

Hazardous Decomposition Products: Reasonably stable; however, in presence of moisture, it hydrolyses rapidly, losing its vesicant property. It also hydrolyses in acidic medium to form HC1 and non-volatile (solid) chlorovinylarsenious oxide, which is less vesicant than Lewisite. Hydrolysis in alkaline medium, as in decontamination with alcoholic caustic or carbonate solution or DS2, produces acetylene and trisodium arsenate (Na_3 As 0_4). Therefore, decontaminated solution would contain toxic arsenic.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, And Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: If leaks or spills of L occur only personnel in full protective clothing will be allowed in the area (See Section VIII). See Section V for emergency and first aid instructions.

Recommended Field Procedures: Lewisite should be contained using vermiculite, diatomaceous earth, clay, or fine sand and neutralized as soon as possible using copious amounts of alcoholic caustic, carbonate, or Decontaminating Agent (DS2). Caution must be exercised when using these decontaminates since acetylene will be given off. Household bleach can also be used if accompanied by stirring to allow contact. Scoop up all material and place in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, the exterior decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminate according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Recommended Laboratory Procedures: A 10 wt.% alcoholic sodium

hydroxide solution is prepared by adding 100 grams of denatured ethanol to 900 grams of 10 wt.% NaOH in water. A minimum of 200 grams of decon is required for each gram of L. The decon and agent solution is agitated for a minimum of one hour. At the end of the hour the resulting pH should be checked and adjusted to above 11.5 using additional NaOH, if required. It is permitted to substitute 10 wt.% alcoholic sodium carbonate made and used in the same ratio as the NaOH listed above. Reaction time should be increased to 3 hours with agitation for the first hour. Final pH should be adjusted to above 10. Scoop up all material and place in an approved DOT container. Cover the contents with decontaminating solution as above. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g., vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

It is permitted to substitute 5.25% sodium hypochlorite for the 10% alcoholic sodium hydroxide solution above. Allow one hour with agitation for the reaction. Adjustment of the pH is not required. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (See Section VIII).

Waste Disposal Method: All neutralized material should be collected and contained for disposal according to land ban RCRA regulations or thermally decomposed in an EPA permitted incinerator equipped with a scrubber that will scrub out the chlorides and equipped with an electrostatic precipitator or other filter device and containerize and label according to DOT and EPA regulations. The arsenic will be disposed of according to land ban RCRA regulations. Any contaminated materials or protective clothing should be decontaminated using alcoholic caustic, carbonates, or bleach analyzed to assure it is free of detectable contamination (3X) level. The clothing should then be sealed in plastic bags inside properly labeled drums and held for shipment back to the DA issue point.

Note: Some decontaminate solutions are hazardous waste according to RCRA regulations and must be disposed of IAW those regulations.

Section VIII - Special Protection Information

Concentration	Respiratory Protective Equipment

< 0.003 mg/m^3	A full face piece, chemical canister, air-purifying protective mask will be on hand for escape. M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used. 
> or = 0.003 mg/m^3 or unknown	NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high Lewisite concentrations with protective ensemble (See DA Pam 385-61 for examples).

Ventilation

Local Exhaust: Mandatory. Must be filtered or scrubbed. Air emissions shall meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) ±20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm ±20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in assessing the ability of the hood to contain Lewisite.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hoods.

Protective Gloves: Butyl Rubber gloves M3 and M4
Norton, Chemical Protective Glove Set

Eye Protection: As a minimum, chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent Lewiste is the M18A2 (yellow band), bubblers (arsenic and GC method), and M256 and A1 kits.

Real-time, low-level monitors (with alarm) are required for Lewisite operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling And Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the workday.

Other Precautions: L should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent will be stored in a single containment system within a laboratory hood or in a double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172

Proper Shipping Name: Toxic liquids, n.o.s.

Dot Hazard Class: 6.1, Packing Group I

Dot Label: Poison

Dot Marking: Toxic liquids, n.o.s.
Dichloro-(2-chlorovinyl)arsine UN 2810

Dot Placard: Poison

Emergency Accident Precautions And Procedures: See Sections IV, VII, and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

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